Appl. No. 09/905,337
Amdt. dated March 19, 2007
Amendment under 37 CFR 1.116 Expedited Procedure
Examining Group 2142

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Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1   1.   (Currently amended) A system for optimizing data access, comprising:

2   a file server capable of communicating with one or more clients; and

3   a plurality of storage elements organized into pairs for storing a plurality of files,

4 each pair having a master storage element and at least one mirrored storage element, and each

5 mirrored storage element ~~having~~ being configured to receive a copy of data stored on the master

6 storage element;

7   wherein the file server maintains file information on where each of the plurality of

8 files is stored on which pair of storage elements, and maintains access load information

9 regarding each one of the pair of storage elements;

10   wherein when a client requests access to file information for a requested file, the

11 file server determines a pair of storage elements for accessing the requested file, and returns to

12 the client a first identifier of a storage element within the pair of storage elements that is to be

13 accessed for reading data, and a second identifier of the master storage element of the pair of

14 storage elements that is to be accessed for writing data, the determination being based upon use

15 of storage elements within the system,

16   ~~wherein when a client requests file information for a requested file from the file~~

17 ~~server, the file server determines which pair of storage elements has the requested file, and~~

18 ~~returns to the client information including a storage element within the pair of storage elements~~

19 ~~that is to be accessed, the storage element being identified based upon use of the storage system,~~

20 ~~and~~

21   ~~wherein the client initiates I/O operations with the identified storage element to~~

22 ~~access the requested file absent the file server.~~

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23   wherein the client initiates I/O operations with the pair of storage elements absent

24   the file server,

25   wherein write operations by the client are made using the first identifier and read

26   operations by the client are made using the second identifier, and

27   wherein data written to the master storage element is copied to the at least one

28   mirrored storage element within each pair of storage elements.

1   2.   (Original) The system according to claim 1 wherein the plurality of

2   storage elements is a plurality of disk drives.

1   3.   (Previously presented) The system according to claim 1 wherein the

2   plurality of storage elements are provided in a single storage system.

1   4.   (Previously presented) The system according to claim 1 wherein the

2   plurality of storage elements are provided in at least two storage systems.

1   5.   (Original) The system according to claim 1 further comprising:

2   a plurality of host computers;

3   wherein the file server resides on one of the plurality of host computers; and

4   wherein the one or more clients reside on remaining ones of the plurality of host

5   computers.

1   6.   (Currently amended) The system according to claim 1 further comprising

2   an apparatus configured to synchronize data stored on each pair of storage elements.

1   7.   (Previously presented) The system according to claim 1 wherein the

2   master storage element and the at least one storage element within a pair are contained in a single

3   storage system.

          8.   (Canceled)

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1   9.   (Previously presented) The system according to claim 1 wherein if it is

2   determined that a mirrored storage element is to be accessed for the requested file and the

3   mirrored storage element which is to be accessed contains a latest copy of data for the requested

4   file stored on the corresponding master storage element, the client directly retrieves the requested

5   file from the mirrored storage element.

1   10.   (Previously presented) The system according to claim 9 wherein if it is

2   determined that a mirrored storage element is to be accessed for the requested file and the

3   mirrored storage element which is to be accessed does not contain a latest copy of data for the

4   requested file stored on the corresponding master storage element, the latest copy of data for the

5   requested file stored on the corresponding master storage element is retrieved from the

6   corresponding master storage element and then forwarded to the client.

1   11.   (Original) The system according to claim 1 wherein the file information

2   on where each of the plurality of files is stored on which pair of storage elements includes file

3   allocation lists.

1   12.   (Previously presented) The system according to claim 1 wherein when

2   determining which of the storage elements within the pair of storage elements having the

3   requested file is to be accessed, consideration is given to ensure that all the storage elements

4   within the pair of storage elements having the requested file are accessed in a substantially

5   balanced manner.

1   13.   (Currently amended) The system according to claim 1 wherein upon

2   determining which of the storage elements within the pair of storage elements having the

3   requested file is to be accessed, the file server forwards ~~information relating to the determination~~

4   <u>a file allocation list for the requested file</u> to the client thereby allowing the client to retrieve the

5   requested file from the determined storage element.

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1   14.   (Currently amended) The system according to claim 13 wherein upon

2   forwarding the <u>file allocation list</u> ~~information relating to the determination~~ to the client, the file

3   server updates the access load information to ensure accurate monitoring of access balance of the

4   pairs.

1   15.   (Currently amended) A system for optimizing data access comprising:

2   a first host computer having a file system server, the first host computer capable

3   of communicating with a second host computer having a file system client;

4   a storage system having a plurality of disk drives organized into pairs for storing a

5   plurality of files, each pair having a master disk drive and at least one mirrored disk drive, each

6   mirrored disk drive ~~having~~ <u>being configured to receive</u> a copy of data stored on the master disk

7   drive;

8   wherein the file system server maintains file information on where each of the

9   plurality of files is stored on each pair of disk drives and further maintains access load

10   information on each pair of disk drives;

11   <u>wherein when a file system client requests access to file information for a</u>

12   <u>requested file, the file server determines a pair of storage elements for accessing the requested</u>

13   <u>file, and returns to the file system client a first identifier of a storage element within the pair of</u>

14   <u>storage elements that is to be accessed for reading data, and a second identifier of the master</u>

15   <u>storage element of the pair of storage elements that is to be accessed for writing data, the</u>

16   <u>determination being based upon use of storage elements within the system,</u>

17   ~~wherein when a file system client requests file information for a requested file~~

18   ~~from the file system server, the file system server determines which pair of disk drives has the~~

19   ~~requested file and returns to the file system client information including a disk drive within the~~

20   ~~pair of disk drives that is to be accessed, the disk drive being identified based upon use of the~~

21   ~~storage system; and~~

22   wherein the file system client, absent the file system server, initiates I/O

23   operations with the identified disk drive to access the requested file

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24   <u>wherein write operations by the file system client are made using the first</u>

25 <u>identifier and read operations by the file system client are made using the second identifier, and</u>

26   <u>wherein data written to the master storage element is copied to the at least one</u>

27 <u>mirrored storage element within each pair of storage elements.</u>

1   16. (Original) The system according to claim 15 wherein the file information

2 on where each of the plurality of files is stored on which pair of disk drives includes file

3 allocation lists.

1   17. (Previously presented) The system according to claim 15 wherein when

2 determining which of the disk drives within the pair of disk drives having the requested file is to

3 be accessed, consideration is given to ensure that all the disk drives within the pair of disk drives

4 having the requested file are accessed in a substantially balanced manner.

1   18. (Currently amended) The system according to claim 15 wherein upon

2 determining which of the disk drives within the pair of disk drives having the requested file is to

3 be accessed, the file system server forwards ~~information relating to the determination~~ <u>a file</u>

4 <u>allocation list for the requested file</u> to the file system client thereby allowing the file system

5 client to retrieve the requested file from the determined disk drive.

1   19. (Currently amended) The system according to claim 18 wherein upon

2 forwarding the ~~information relating to the determination~~ <u>file allocation list</u> to the file system

3 client, the file system server updates the access load information to ensure accurate monitoring

4 of access balance of the pairs.

1   20. (Currently amended) A system for optimizing data access comprising:

2   a first host computer having a file system server, the first host computer capable

3 of communicating with a second host computer having a file system client;

4   a plurality of storage systems, each of the plurality of storage systems having a

5 plurality of disk drives, the plurality of disk drives from the plurality of storage systems being

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6   collectively organized into pairs for storing a plurality of files, each pair having a master disk

7   drive and at least one mirrored disk drive, each mirrored disk drive being configured to receive

8   ~~having~~ a copy of data stored on the master disk drive;

9   wherein the file system server maintains file information on where each of the

10   plurality of files is stored on which pair of disk drives and further maintains access load

11   information on each pair of disk drives;

12   wherein when a file system client requests access to file information for a

13   requested file, the file server determines a pair of storage elements for accessing the requested

14   file, and returns to the file system client a first identifier of a storage element within the pair of

15   storage elements that is to be accessed for reading data, and a second identifier of the master

16   storage element of the pair of storage elements that is to be accessed for writing data, the

17   determination being based upon use of storage elements within the system,

18   ~~wherein when a file system client requests file information for a requested file~~

19   ~~from the file system server, the file system server determines which pair of disk drives has the~~

20   ~~requested file and returns to the file system client information including a disk drive within the~~

21   ~~pair of disk drives that is to be accessed, the disk drive being identified based upon use of the~~

22   ~~storage system; and~~

23   wherein the file system client, absent the file system server, initiates I/O

24   operations with the identified disk drive to access the requested file

25   wherein write operations by the file system client are made using the first

26   identifier and read operations by the file system client are made using the second identifier, and

27   wherein data written to the master storage element is copied to the at least one

28   mirrored storage element within each pair of storage elements.

1   21.   (Original) The system according to claim 20 wherein the file information

2   on where each of the plurality of files is stored on which pair of disk drives includes file

3   allocation lists.

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1   22.   (Previously presented) The system according to claim 20 wherein when

2 determining which of the disk drives within the pair of disk drives having the requested file is to

3 be accessed, consideration is given to ensure that all the disk drives within the pair of disk drives

4 having the requested file are accessed in a substantially balanced manner.

1   23.   (Currently amended) The system according to claim 20 wherein upon

2 determining which of the disk drives within the pair of disk drives having the requested file is to

3 be accessed, the file system server forwards ~~information relating to the determination~~ a file

4 allocation list for the requested file to the file system client thereby allowing the file system

5 client to retrieve the requested file from the determined disk drive.

1   24.   (Currently amended) The system according to claim 23 wherein upon

2 forwarding the ~~information relating to the determination~~ file allocation list to the file system

3 client, the file system server updates the access load information to ensure accurate monitoring

4 of access balance of the pairs.

1   25.   (Original) The system according to claim 20 wherein if it is determined

2 that a mirrored disk drive is to be accessed for the requested file and the mirrored disk drive

3 which is to be accessed contains a latest copy of data for the requested file stored on the

4 corresponding master disk drive, the file system client directly retrieves the requested file from

5 the mirrored disk drive.

1   26.   (Original) The system according to claim 20 wherein if it is determined

2 that a mirrored disk drive is to be accessed for the requested file and the mirrored disk drive

3 which is to be accessed does not contain a latest copy of data for the requested file stored on the

4 corresponding master disk drive, the latest copy of data for the requested file stored on the

5 corresponding master disk drive is retrieved from the corresponding master disk drive and then

6 forwarded to the file system client.

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1   27.   (Currently amended) A method for optimizing data access comprising:

2   organizing a plurality of storage elements into pairs for storing a plurality of files,

3 each pair having a master storage element and at least one mirrored storage elements, each

4 mirrored storage element being configured to receive ~~having~~ a copy of data stored on the master

5 storage element;

6   maintaining file information on where each of the plurality of files is stored on

7 each pair of storage elements;

8   maintaining access load information on each one of the pair of storage elements;

9   upon receiving a request for a requested file, determining a pair of storage

10 elements for accessing the requested file,

11   ~~upon receiving a request for a requested file, determining which pair of storage~~

12 ~~elements has the requested file, and then determining which storage element within the pair of~~

13 ~~storage elements is to be accessed; and~~

14   returning file access information including a first identifier of a storage element

15 within the pair of storage elements that is to be accessed for reading data, and a second identifier

16 of the master storage of the pair of storage elements that is to be accessed for writing data, the

17 first identifier being selected ~~storage element being identified~~ based upon use of the storage

18 elements, ~~system,~~

19   ~~wherein I/O operations are initiated with the identified storage element using the~~

20 ~~file access information, and~~

21   wherein said file access information is returned to a client thereby allowing the

22 client to retrieve the requested file absent a file server,

23   wherein write operations by the client are made using the first identifier and read

24 operations by the client are made using the second identifier, and

25   wherein data written to the master storage element is copied to the at least one

26 mirrored storage element within each pair of storage elements.

      28.   (Canceled)

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1   29.   (Previously presented) The method of claim 27 further comprising upon

2   returning file access information to the client, updating the access load information to ensure

3   accurate monitoring of access balance of the pairs.

1   30.   (Original) The method according to claim 27 wherein the plurality of

2   storage elements are stored on a single storage system.

1   31.   (Previously presented) The method according to claim 27 wherein the

2   plurality of storage elements are stored in at least one storage system.

1   32.   (Previously presented) The method according to claim 31 further

2   comprising upon determining that a mirrored storage element is to be accessed for the requested

3   file and the mirrored storage element which is to be accessed contains a latest copy of data for

4   the requested file stored on the corresponding master storage element, retrieving the requested

5   file from the mirrored storage element directly.

1   33.   (Previously presented) The method according to claim 31 further

2   comprising upon determining that a mirrored storage element is to be accessed for the requested

3   file and the mirrored storage element which is to be accessed does not contain a latest copy of

4   data for the requested file stored on the corresponding master storage element, retrieving the

5   latest copy of data for the requested file stored on the corresponding master storage element from

6   the corresponding master storage element.

1   34.   (Original) The method according to claim 27 wherein when determining

2   which of the storage elements within the pair of storage elements having the requested file is to

3   be accessed, consideration is given to ensure that all the storage elements within the pair of

4   storage elements having the requested file are substantially accessed in a balanced manner.

1   35.   (Original) The method according to claim 27 wherein the plurality of

2   storage elements includes a plurality of disk drives.

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1   36.   (Currently amended) A method for optimizing data access between a file

2 server and at least one or more clients comprising:

3   organizing a plurality of disk drives into pairs for storing a plurality of files, each

4 pair having a master disk drive and at least one mirrored disk drive, and each mirrored disk drive

5 <u>being configured to receive</u> ~~having~~ a copy of data stored on the master drive;

6   maintaining file information on where each of the plurality of files is stored on

7 which pair of disk drives;

8   maintaining access load information on each pair of disk drives, wherein the file

9 information and the access load information are maintained at the file server;

10   <u>upon receiving a request for a requested file, determining a pair of storage</u>

11 <u>elements for accessing the requested file based upon a usage level of its corresponding storage</u>

12 <u>elements, and</u>

13   ~~upon the file server receiving a request for a requested file from a client, causing~~

14 ~~the file server to determine which pair of disk drives has the requested file by using the file~~

15 ~~information, and then causing the file server to identify which disk drive within the pair of disk~~

16 ~~drives is to be accessed by using the access load information; and~~

17   forwarding <u>to the client a first identifier of a storage element within the pair of</u>

18 <u>storage elements that is to be accessed for reading data, and a second identifier of the master</u>

19 <u>storage within the pair of storage elements for writing data</u> ~~information relating to the identified~~

20 ~~disk drive to the client~~ thereby allowing the client to initiate I/O operations, absent the file server,

21 to ~~retrieve~~ <u>access</u> the requested file.